

**NDEQ Petroleum Remediation Section
RBCA Guidance Document**

**APPENDIX A:
PAH EVALUATION USING TOTAL HYDROCARBONS ANALYSIS**

SURROGATE METHOD FOR THE CONVERSION OF PAH RBSLs TO THE DEFAULT TEH VALUES

Due to potential difficulties with achieving the minimum quantification levels required by the Department for the polycyclic aromatic hydrocarbons (PAH) chemicals of concern (naphthalene, pyrene and benzo(a)pyrene), the Department developed an alternate method for the Tier 1 site screening of these chemicals using a Total Extractable Hydrocarbon (TEH) analysis method. In this surrogate method, default TEH risk-based screening levels (RBSLs) are developed based on the chemical-specific RBSLs and the assumed concentration of the chemical in the original product.

DIESEL FUEL

It is assumed here that diesel fuel contains the PAH chemicals of concern in the following percentages (by weight):

Naphthalene	0.2%
Pyrene	0.001%
Benzo(a)pyrene	0.001%

TEH values for each chemical-specific RBSL were calculated by dividing the RBSL by the percentage of the chemical in the product, providing a relative TEH level for the chemical concentration. For each exposure pathway, the lowest TEH value calculated was chosen as the default "TEH as Diesel" RBSL found in the Tier 1 Look-Up Tables.

The TEH values calculated for each chemical-specific RBSL are found in the accompanying tables in this appendix. The values used in the Tier 1 Look-Up Tables are shown in bold typeface.

WASTE OIL

It is assumed here that waste oil contains the PAH chemicals of concern in the following percentages (by weight):

Naphthalene	0.0%
Pyrene	0.0%
Benzo(a)pyrene	0.003%

Since benzo(a)pyrene (BaP) is the only PAH chemical of concern typically associated with waste oil, TEH values were calculated by dividing the BaP RBSL, where applicable, by the percentage of BaP in the product, providing a relative TEH level for BaP. For each applicable exposure pathway of concern, this TEH value was used as the default "TEH as Waste Oil" RBSL found in the Tier 1 Look-Up Tables.

The TEH value calculated for each BaP RBSL are found in the accompanying tables in this appendix, indicated by the bold typeface.

Table A-1. PAH as TEH Values: Ground Water Ingestion Exposure Pathway

		Tier 1 RBSLs			Default TEH as Diesel			Default TEH as Waste Oil		
		Naphthalene	Pyrene	BaP	Naphthalene	Pyrene	BaP	Naphthalene	Pyrene	BaP
Sands										
RAC-1	0	0.02	0.02	0.0002	10	2000	20			6.66
	250	1.4	>Sol	>Sol	700					
	500	10.4	>Sol	>Sol	5200					
	750	>Sol	>Sol	>Sol						
RAC-2	[500]	>Sol	>Sol	>Sol						
Silts/Clays										
RAC-1	0	0.02	0.02	0.0002	10	2000	20			6.66
	250	>Sol	>Sol	>Sol						
	500	>Sol	>Sol	>Sol						
RAC-2	[500]	>Sol	>Sol	>Sol						

Notes:

- 1) Values provided in milligrams per liter (mg/L) or approximately parts per million (ppm)
- 2) BaP: Benzo(a)pyrene
- 3) >Sol: The selected target level is not exceeded for all possible dissolved levels

Table A-2. PAH as TEH Values: Soil Leaching to Ground Water Exposure Pathway

Ground Water 0-50 ft

		Tier 1 RBSLs			Default TEH as Diesel			Default TEH as Waste Oil		
		Naphthalene	Pyrene	BaP	Naphthalene	Pyrene	BaP	Naphthalene	Pyrene	BaP
Sands										
RAC-1	0	32.2	>Sat	>Sat	16,100					
	250	>Sat	>Sat	>Sat						
RAC-2	[500]	>Sat	>Sat	>Sat						
Silts/Clays										
RAC-1	0	1.54	>Sat	4.58	770	>100%	460,000			152,266
	250	>Sat	>Sat	>Sat						
RAC-2	[500]	>Sat	>Sat	>Sat						

Ground Water >50 ft

		Tier 1 RBSLs			Default TEH as Diesel			Default TEH as Waste Oil		
		Naphthalene	Pyrene	BaP	Naphthalene	Pyrene	BaP	Naphthalene	Pyrene	BaP
Sands										
RAC-1	0	64.4	>Sat	>Sat	32,000					
	250	>Sat	>Sat	>Sat						
RAC-2	[500]	>Sat	>Sat	>Sat						
Silts/Clays										
RAC-1	0	3.07	>Sat	9.15	1535		919,000			305,000
	250	>Sat	>Sat	>Sat						
RAC-2	[500]	>Sat	>Sat	>Sat						

Notes:

- 1) Values provided in milligrams per kilogram (mg/kg) = parts per million (ppm)
- 2) BaP: Benzo(a)pyrene
- 3) >Sat: The selected target level is not exceeded for all possible saturated levels in soil.

**NDEQ Petroleum Remediation Section
RBCA Guidance Document**

**APPENDIX B:
TIER 1 REPORT FORMS**



Nebraska Department
of Environmental Quality

RBCA Tier 1 Site Investigation Report Forms for Petroleum Release Sites

(For Use by Consultants)

FACILITY NAME:	
LOCATION:	
NDEQ SPILL NO.:	
NDEQ IIS NO.:	
CONSULTANT PROJECT NO.:	
CONSULTANT:	
COMPLETION DATE:	
PREPARED BY:	
REVIEWED BY:	

NDEQ RBCA TIER 1 REPORT FORMS

TABLE OF CONTENTS

Form No.	Description	Check box if included
FORMS FOR USE BY RP/CONSULTANT		
1.	Executive Summary	<input type="checkbox"/>
2.	Facility/File Information	<input type="checkbox"/>
3.	Release Characterization	<input type="checkbox"/>
4.	Land Use	<input type="checkbox"/>
5.	Water Use	<input type="checkbox"/>
	5a. Ground Water and Surface Water Use	<input type="checkbox"/>
	5b. Water Supply Well Location Information	<input type="checkbox"/>
6.	Enclosed Spaces	<input type="checkbox"/>
7.	Instructions for Investigation Narrative	<input type="checkbox"/>
8.	Site Stratigraphy and Hydrogeology	<input type="checkbox"/>
9.	Analytical Data Summary for Surface Soil (0-3 ft bgl)	<input type="checkbox"/>
10.	Analytical Data Summary for Subsurface Soil (>3 ft bgl)	<input type="checkbox"/>
11.	Analytical Data Summary for Ground Water	<input type="checkbox"/>
	11a. Analytical Data Summary for QA/QC Water Samples	<input type="checkbox"/>
12.	Free Product	<input type="checkbox"/>
13.	References and Protocols	<input type="checkbox"/>
ATTACHMENTS		
<i>All maps submitted must include a bar scale, legend, north arrow, location of all known soil borings and monitoring wells, and date of map, where appropriate.</i>		
1.	Topographic Map	<input type="checkbox"/>
2.	Area Map	<input type="checkbox"/>
3.	Site Map	<input type="checkbox"/>
4.	Free Product Map	<input type="checkbox"/>
5.	Boring Logs	<input type="checkbox"/>
6.	Monitoring Well Schematics	<input type="checkbox"/>
7.	Laboratory Analysis Sheets and Chain-of-Custody Sheets	<input type="checkbox"/>
8.	Geologic Cross Sections	<input type="checkbox"/>
9.	Well Survey Documentation	<input type="checkbox"/>
OTHER ATTACHMENTS:		

NDEQ RBCA TIER 1 REPORT

Tier 1 Investigation Form - 1

FACILITY NAME: _____ **CONSULTANT:** _____

NDEQ SPILL NO.: _____ **NDEQ IIS NO.:** _____

COMPLETION DATE: _____ **PREPARED BY:** _____

EXECUTIVE SUMMARY

Facility or file name:	_____		
Current facility name (if different from above):	_____		
Facility address or site location:	_____		
Status of fuel storage/distribution:	<input type="checkbox"/> Active	<input type="checkbox"/> Inactive	<input type="checkbox"/> NA
Is surface soil contamination present?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Are subsurface soils impacted?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Is ground water impacted?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA
Has the source(s) of release been identified?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Was free product detected during the Tier 1 investigation?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	_____
If yes, was the free product plume fully delineated?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	_____
Were vapors detected in any on-site subsurface structures?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	_____
Has surface water been impacted by the release?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	_____
Were emergency actions initiated?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	_____
Average depth of contamination in subsurface soils:	_____ ft	_____ cm	
Shallowest depth to ground water:	_____ ft	<input type="checkbox"/> Not measured	
Average depth to ground water:	_____ ft	<input type="checkbox"/> Not measured	
Distance to nearest drinking water supply well:	_____ ft	<input type="checkbox"/> municipal	<input type="checkbox"/> domestic
Distance to nearest non-potable water supply well:	_____ ft	type: _____	
Distance to nearest downgradient water supply well:	_____ ft	<input type="checkbox"/> municipal	<input type="checkbox"/> domestic
Is there evidence of vertical migration of the contaminant plume?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA

Statement of Completion & Responsible Party/Consultant Signature Block

The consultant representative acknowledges that this report meets the minimum requirements for a Tier 1 investigation at this petroleum release site, as specified in the Department's Risk-Based Corrective Action (RBCA) at Petroleum Release Sites: Tier 1/Tier 2 Assessments and Reports Guidance Document. Any procedures that differ from the guidance document specifications are noted in the report, were approved by the Department and are accompanied by appropriate documentation. The responsible party acknowledges that they have read (or discussed with their consultant), this site investigation report and are aware of their responsibility for the timely submission to the Department.

_____	_____	_____	_____
Consultant Representative Signature	Date	Responsible Party Signature	Date

ADDITIONAL NOTES

Recommended attachments: None.

NDEQ RBCA TIER 1 REPORT**Tier 1 Investigation Form - 2****FACILITY NAME:****CONSULTANT:****NDEQ SPILL NO.:****NDEQ IIS NO.:****COMPLETION DATE:****PREPARED BY:****FACILITY/FILE INFORMATION**

Facility or file name:

Facility address or site location:

County:

Legal Location (¼, ¼, ¼, Sec, T, R):

Latitude (degrees, min., sec.):

Longitude (degrees, min., sec.):

Responsible Party:

Responsible Party mailing address:

Responsible Party phone number:

Property owner:

Property owner mailing address:

Property owner phone number:

Consulting Firm:

Consulting Firm mailing address:

Consulting Firm Project Manager:

Consultant phone number:

ADDITIONAL NOTES**Recommended attachments:** Topographic map

NDEQ RBCA TIER 1 REPORT

Tier 1 Investigation Form - 3

FACILITY NAME: _____ **CONSULTANT:** _____

NDEQ SPILL NO.: _____ **NDEQ IIS NO.:** _____

COMPLETION DATE: _____ **PREPARED BY:** _____

RELEASE CHARACTERIZATION

PETROLEUM RELEASE HISTORY

<u>NDEQ Spill Number</u>	<u>Location/Source</u>	<u>Product/Quantity</u>

SOURCE(S) OF RELEASE (Check all that apply)

- Surface Spills
- Load Out Racks (includes overfills)
- Piping
- Dispenser Islands (includes vessel overfills)
- USTs (includes UST overfills)
- ASTs (includes AST overfills)
- Transportation Vessels
- Interstate/Intrastate Pipelines
- Unknown
- Other (specify) _____

SUBSTANCE(S) RELEASED (Check all that apply)

- Gasoline
- Diesel/#2 Fuel Oil
- Used Oil
- AV Gas
- Jet Fuel: **JP** _____
- Kerosene
- Other Fuel Oil/Heavy Distillate (specify) _____

Other product (specify) _____

SUMMARY OF RELEASE

(Provide explanatory notes below)

Has the source(s) of release been identified?	<input type="checkbox"/> YES <input type="checkbox"/> NO	_____
Has the release been abated?	<input type="checkbox"/> YES <input type="checkbox"/> NO	_____
Were emergency actions initiated?	<input type="checkbox"/> YES <input type="checkbox"/> NO	_____
Are surface soils impacted?	<input type="checkbox"/> YES <input type="checkbox"/> NO	_____
Are subsurface soils impacted?	<input type="checkbox"/> YES <input type="checkbox"/> NO	_____
Is ground water impacted?	<input type="checkbox"/> YES <input type="checkbox"/> NO	<input type="checkbox"/> Not sampled, drilled out of contamination
Were vapors detected in any utilities?	<input type="checkbox"/> YES <input type="checkbox"/> NO	_____
Were vapors detected in any on-site subsurface structures?	<input type="checkbox"/> YES <input type="checkbox"/> NO	_____
Is surface water impacted?	<input type="checkbox"/> YES <input type="checkbox"/> NO	_____
Has a sensitive habitat/resource been impacted?	<input type="checkbox"/> YES <input type="checkbox"/> NO	_____

ADDITIONAL NOTES

Recommended attachments: None.

FACILITY NAME: _____ **CONSULTANT:** _____

NDEQ SPILL NO.: _____ **NDEQ IIS NO.:** _____

COMPLETION DATE: _____ **PREPARED BY:** _____

LAND USE

Currently operating as a service station or petroleum bulk facility. If not, site currently used as: _____
 Tanks temporarily out of service Tanks permanently out of service

Current On-site Land Use	
Residential	<input type="checkbox"/>
Commercial	<input type="checkbox"/>

Future On-site Land Use	
Residential	<input type="checkbox"/>
Commercial	<input type="checkbox"/>

Comments: *Justify the choice for future land use.*

Off-site Land Use (within 500 feet - at a minimum, state whether residential, agricultural, commercial, or sensitive population center)

North: _____
 Northeast: _____
 Northwest: _____
 South: _____
 Southeast: _____
 Southwest: _____
 West: _____
 East: _____

ADDITIONAL POINT OF EXPOSURE SURVEY

	Distance (feet)	Direction
Nearest residential site (≤500 ft):		
Nearest commercial site (≤500 ft):		
Nearest habitable building (≤500 ft):		
Nearest ecologically sensitive area, e.g., wetland (≤1000 ft):		
Nearest school, hospital, day care, retirement home, etc. (≤500 ft):		

ADDITIONAL NOTES

Recommended attachments: Site map with detailed land use in the vicinity of the site, Area map.

FACILITY NAME:

NDEQ SPILL NO.:

NDEQ IIS NO.:

CONSULTANT:

COMPLETION DATE: 00-Jan-00

PREPARED BY:

GROUND WATER AND SURFACE WATER USE

Ground Water - Current Use

Well Designation	Well Type/Use	Distance (ft)	Direction

Surface Water - Current Use

Surface Water Type	Beneficial Use	Distance (ft)	Direction

Ground Water & Surface Water - Future Use

Are the RP, current property owner (if different than RP), adjacent landowners, and/or local municipal authorities aware of potential future ground and/or surface water use development within the next five years?

Ground Water *Surface Water*
 Yes No Yes No

If yes, provide the following information. Include contact information in Notes below and/or Form 5b.

Location	Type of New Use

NOTES: 1) Justify choice of future ground water use; also indicate if water supply well may have some influence over vertical migration of plume.
 2) Justify choice for future surface water use and type of water body.

Recommended attachments: Area map with well and surface water locations.

NDEQ RBCA TIER 1 REPORT	Tier 1 Investigation Form - 6
--------------------------------	--------------------------------------

FACILITY NAME:	CONSULTANT:
-----------------------	--------------------

NDEQ SPILL NO.:	NDEQ IIS NO.:
------------------------	----------------------

COMPLETION DATE:	PREPARED BY:
-------------------------	---------------------

ENCLOSED SPACES

NO ENCLOSED SPACES ASSOCIATED WITH RELEASE LOCATION

ON-SITE SUBSURFACE UTILITIES

Indicate which of the following utilities currently act as conduits or are potentially liable to become conduits under the columns entitled "Impacted by release," and "Potentially Impacted by Release," respectively.

	Depth [feet]	Construction material	Fill Material	Flow direction	Impacted by release	Potentially impacted by release
<input type="checkbox"/> Sanitary sewer						
<input type="checkbox"/> Covered storm sewer						
<input type="checkbox"/> Water line						
<input type="checkbox"/> Gas line						
<input type="checkbox"/> Electric line						
<input type="checkbox"/> Telephone line						
Other:						
<input type="checkbox"/>						
<input type="checkbox"/>						

ON-SITE & ADJACENT PROPERTY (within 200 ft) BUILDINGS
--

Building Location	Direction <i>(Cross, Down, Upgradient)</i>	Distance from source area(s)	Use	Basement or other subgrade present? <i>(e.g. crawl space, daylight room)</i>	
				Type of structure	Depth (ft bgl)

VAPOR ASSESSMENT

Subsurface Structure Screened	Location	PID/FID (ppm)	CGI (%LEL)

Recommended attachments: Site map with locations of utilities, tanks and ancillary equipment, and vapor sampling locations.

FACILITY NAME:

CONSULTANT:

NDEQ SPILL NO.:

NDEQ IIS NO.:

COMPLETION DATE: 00-Jan-00

PREPARED BY:

INSTRUCTIONS FOR INVESTIGATION NARRATIVE

Note: The reporter may use a format of their choosing for the following narrative information, with the provision that all the minimum information requirements listed below are provided under the following headings and in the order outlined. Place the narrative behind a copy of this Investigation Form in the Tier 1 Report.

- I. Brief history of any abatement/remedial actions taken prior to initiating the Tier 1 investigation
- II. Summary of site characteristics
 - A. Site Location
 - B. General site topography, geology, and hydrogeology
- III. Summary of drilling activities
 - A. Date/method/equipment
 - B. Drilling order of boreholes
 - C. Drilling complications (e.g., auger failure or refusal, site recently modified), if any
 - D. Description of materials drilled through and evidence of contamination
 - E. Monitoring well installation
 - depth of wells
 - filter pack and grout materials
 - screened interval
 - type of well head protection
 - well development methodology, duration, estimated water removed
 - other information
 - F. Monitoring well location information
 - nature and location of permanent benchmark to which wells are referenced (designate on site map)
 - method (e.g., stadia, measuring wheel, tape) and measurements (in tabular format) used to reference wells to benchmark
 - G. Other information related to drilling activities (e.g., start/stop times for drilling & well installation)
- IV. Direct push technologies
 - A. Date/method/equipment
 - B. Order of probe locations
 - C. Description of materials drilled through and evidence of contamination
 - D. Other information related to direct push activities (e.g., start/stop times, media investigated)
- V. Summary of sampling activities
 - A. Soil sampling
 - method of sample collection
 - method/protocol used for head space analysis
 - method/protocol used for laboratory sample preparation
 - B. Ground water sampling
 - purging method/protocol/criteria (includes rationale for not purging, if applicable)
 - sample collection method/protocol
 - order of well sampling (Note: sample least contaminated to most contaminated)
 - C. Drinking water supply well/system sampling
 - location of sampling point (e.g., directly from well, outdoor tap, indoor tap)
 - purging method/protocol/criteria
 - sample collection method/protocol
 - D. QA/QC considerations
 - steps taken to limit cross-contamination between sampling locations
 - number/type/location of duplicates/blanks
 - decontamination protocol and other measures taken to minimize cross-contamination
- VI. Other information
 - A. Rationale for variances from approved work plan or RBCA guidance document
 - B. Contact information (i.e., names, phone numbers, affiliations) for people providing information gathered during investigation

NDEQ RBCA TIER 1 REPORT	Tier 1 Investigation Form - 9
--------------------------------	--------------------------------------

FACILITY NAME:	NDEQ SPILL NO.:	NDEQ IIS NO.:
-----------------------	------------------------	----------------------

CONSULTANT:	COMPLETION DATE:	PREPARED BY:
--------------------	-------------------------	---------------------

ANALYTICAL DATA SUMMARY FOR SURFACE SOIL (Soil sample depth between 0-3 feet bgl; All concentrations in mg/kg)
<input type="checkbox"/> NOT APPLICABLE FOR THIS SITE

Sample No.	Sampling Date	Sample Depth (ft)					Arithmetic Average	Maximum	Ratio (Maximum/ Arithmetic Average) *
------------	---------------	-------------------	--	--	--	--	-----------------------	---------	--

VOLATILE ORGANIC CHEMICALS ANALYSES									
--	--	--	--	--	--	--	--	--	--

Benzene									
Toluene									
Ethylbenzene									
Xylenes (total)									
n-Hexane									
Methyl-tert-butyl-ether (MTBE)									

TOTAL EXTRACTABLE HYDROCARBONS ANALYSES									
--	--	--	--	--	--	--	--	--	--

TEH (as diesel)									
TEH (as waste oil)									
TEH (as kerosene)									
TEH as									
TEH as									
TEH as									

OTHER ANALYTES									
-----------------------	--	--	--	--	--	--	--	--	--

NOTE:
 Provide any laboratory analytical data sheets not previously submitted to the Department.
 Non-detects can be expressed as ND, BDL, etc.
 * : If the ratio is high (for example >10) there may be a "hot spot" and additional investigation/evaluation may be warranted. In such circumstances, contact the Department.

Recommended Attachments: Site map showing location(s) of surface soil sample(s), chemical concentration maps, laboratory analysis reports, and chain of custody.

NDEQ RBCA TIER 1 REPORT

Tier 1 Investigation Form - 11

FACILITY NAME:	NDEQ SPILL NO.:	NDEQ IIS NO.:
-----------------------	------------------------	----------------------

CONSULTANT:	COMPLETION DATE:	PREPARED BY:
--------------------	-------------------------	---------------------

ANALYTICAL DATA SUMMARY FOR GROUND WATER (All concentrations in mg/L)

NOT APPLICABLE FOR THIS SITE

Monitoring Well Number								Arithmetic Average	Maximum	Ratio of Maximum and Average *
Installation Date										
Screen Interval (feet below datum)										
Water Level (feet below datum)										
Last Sampling Event										

VOLATILE ORGANIC CHEMICALS ANALYSES

Benzene										
Toluene										
Ethylbenzene										
Xylenes (total)										
n-Hexane										
Methyl-tert-butyl-ether (MTBE)										

TOTAL EXTRACTABLE HYDROCARBON ANALYSIS

TEH (as diesel)										
TEH (as waste oil)										
TEH (as kerosene)										
TEH as										
TEH as										
TEH as										

OTHER ANALYTES

NOTE: Provide any laboratory analytical data sheets not previously submitted to the Department. Add additional sheets as needed. Page 1 of

* : If the ratio is high (for example >10) there may be a "hot spot" and additional investigation/evaluation may be warranted. In such circumstances, contact the Department.

Recommended Attachment: Site map showing location(s) of monitoring well(s), chemical concentration maps, laboratory analysis report(s), chain of custody, boring logs, and monitoring well schematics.

NDEQ RBCA TIER 1 REPORT	Tier 1 Investigation Form - 11a
--------------------------------	--

FACILITY NAME:	CONSULTANT:
----------------	-------------

NDEQ SPILL NO.:	NDEQ IIS NO.:
-----------------	---------------

COMPLETION DATE:	PREPARED BY:
------------------	--------------

ANALYTICAL DATA SUMMARY FOR QA/QC WATER SAMPLES (All concentrations in mg/L)
<input type="checkbox"/> NOT APPLICABLE FOR THIS SITE

Type of QA/QC Water Sample	Blind Duplicates		Field Blanks		Trip Blanks	
Sample Designation						
Sample Date						
Field Blank Exposure Time (min)						

VOLATILE ORGANIC CHEMICALS ANALYSES						
Benzene						
Toluene						
Ethylbenzene						
Xylenes (total)						
n-Hexane						
Methyl-tert-butyl-ether (MTBE)						

TOTAL EXTRACTABLE HYDROCARBON ANALYSIS						
TEH (as diesel)						
TEH (as waste oil)						
TEH (as kerosene)						
TEH as						
TEH as						
TEH as						

OTHER ANALYTES						

TEMPERATURE BLANKS	Cooler ID	Pre-Delivery Temp. (°C)	Laboratory Temp (°C)	Cooler ID	Pre-Delivery Temp. (°C)	Laboratory Temp (°C)

NOTE: Provide any laboratory analytical data sheets not previously submitted to the Department.
Recommended Attachment: Laboratory analysis report(s) and chain of custody.

NDEQ RBCA TIER 1 REPORT	Tier 1 Investigation Form - 12
--------------------------------	---------------------------------------

FACILITY NAME:	CONSULTANT:
NDEQ SPILL NO.:	NDEQ IIS NO.:
COMPLETION DATE:	PREPARED BY:

FREE PRODUCT

Is free product present at the site?	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<div style="background-color: yellow; height: 15px;"></div>
<i>(Note if NO, proceed to the next report form)</i>			
Has free product been found in any utility?	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<div style="background-color: yellow; height: 15px;"></div>
Has the free product plume been delineated?	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<div style="background-color: yellow; height: 15px;"></div>
Shallowest depth to free product:	<div style="background-color: yellow; height: 15px;"></div>		
Type of free product released:	<div style="background-color: yellow; height: 15px;"></div>		
Number of monitoring wells currently at the site:	<div style="background-color: yellow; height: 15px;"></div>		
List the monitoring wells containing free product:	<div style="background-color: yellow; height: 15px;"></div>		
Specify the well ID and maximum free product thickness:			
<div style="background-color: yellow; width: 200px; height: 15px;"></div>	<div style="background-color: yellow; width: 100px; height: 15px;"></div>	feet	Date: <div style="background-color: yellow; width: 100px; height: 15px;"></div>

VAPOR ASSESSMENT

Place vapor assessment information in Tier 1 Investigation Form - 6.

REMEDIATION

Has free product removal been initiated?	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<div style="background-color: yellow; height: 15px;"></div>
If YES, specify method of removal (bailer, pump, etc.)?	<div style="background-color: yellow; height: 15px;"></div>		
Frequency of removal (continuously, weekly, etc.):	<div style="background-color: yellow; height: 15px;"></div>		
Total number of recovery events to date:	<div style="background-color: yellow; height: 15px;"></div>		
Total amount of purge-water recovered:	<div style="background-color: yellow; height: 15px;"></div>		
Total amount of free product recovered:	<div style="background-color: yellow; height: 15px;"></div>		
Date of latest free product report submittal:	<div style="background-color: yellow; height: 15px;"></div>		

ADDITIONAL NOTES

Recommended attachments: Free product thickness maps as appropriate. Place narrative detailing free product effort in Form - 7.

NDEQ RBCA TIER 1 REPORT

Tier 1 Investigation Form - 13

FACILITY NAME: _____ **CONSULTANT:** _____

NDEQ SPILL NO.: _____ **NDEQ IIS NO.:** _____

COMPLETION DATE: _____ **PREPARED BY:** _____

REFERENCES AND PROTOCOLS

**NDEQ Petroleum Remediation Section
RBCA Guidance Document**

**APPENDIX C:
TIER 2 REPORT FORMS**



Nebraska Department
of Environmental Quality

RBCA Tier 2 Site Investigation Report Forms for Petroleum Release Sites

(For Use by Consultants)

FACILITY NAME:	
LOCATION:	
NDEQ SPILL NO.:	
NDEQ IIS NO.:	
CONSULTANT PROJECT NO.:	
CONSULTANT:	
COMPLETION DATE:	
PREPARED BY:	
REVIEWED BY:	

NDEQ RBCA TIER 2 REPORT FORMS

TABLE OF CONTENTS

Form No.	Description	Check box if included
FORMS FOR USE BY RP/CONSULTANT		
1.	Executive Summary	<input type="checkbox"/>
2.	Instructions for Tier 2 Investigation Narrative	<input type="checkbox"/>
3.	Site Stratigraphy and Hydrogeology	<input type="checkbox"/>
4.	Site-Specific Vadose Zone Parameters	<input type="checkbox"/>
5.	Analytical Data Summary for Subsurface Soil (>3 ft bgl)	<input type="checkbox"/>
6.	Analytical Data Summary for Ground water	<input type="checkbox"/>
6a.	Analytical Data Summary for QA/QC Water Samples	<input type="checkbox"/>
7.	Analytical Data Summary for Soil Gas Samples	<input type="checkbox"/>
8.	References and Protocols	<input type="checkbox"/>
ATTACHMENTS		
<i>All maps submitted must include a bar scale, legend, north arrow, location of all known soil boring and monitoring wells, and date of map, where appropriate.</i>		
Attachment No.	Description	Check box if included
1.	Area Map	<input type="checkbox"/>
2.	Site Map	<input type="checkbox"/>
3.	Contaminant Plume Maps	<input type="checkbox"/>
4.	Free Product Map	<input type="checkbox"/>
5.	Boring Logs	<input type="checkbox"/>
6.	Monitoring Well Schematics	<input type="checkbox"/>
7.	Laboratory Analysis Sheets and Chain-of-Custody Sheets	<input type="checkbox"/>
8.	Geologic cross-sections	<input type="checkbox"/>
9.	Well Survey Documentation	<input type="checkbox"/>
OTHER ATTACHMENTS:		

NDEQ RBCA TIER 2 REPORT

Tier 2 Investigation Form - 1

FACILITY NAME:

CONSULTANT:

NDEQ SPILL NO.:

NDEQ IIS NO.:

COMPLETION DATE:

PREPARED BY:

EXECUTIVE SUMMARY

Facility or file name:

Current facility name (if different from above):

Facility address or site location:

Status of fuel storage/distribution:

Active Inactive NA

Was surface soil remediated after the Tier 1 investigation?

Yes No

This Tier 2 investigation pertains to:

Ground Water Ingestion Pathway

Yes No

Soil Leaching to Ground Water Pathway

Yes No

Enclosed Space Inhalation from Soils Pathway

Yes No

Enclosed Space Inhalation from Gound Water Pathway

Yes No

Was free product detected during the Tier 1 investigation?

Yes No

If yes, was the free product removed prior to Tier 2 investigation?

Yes No

Were vapors detected in any utilities?

Yes No

Has surface water been impacted by the release?

Yes No

Average depth of contamination in subsurface soils:

_____ ft _____ cm NA

Shallowest depth to ground water:

_____ ft NA

Average depth to ground water:

_____ ft NA

Distance to nearest drinking water supply well:

_____ ft NA

Distance to nearest non-potable water supply well:

_____ ft NA

Distance to nearest downgradient water supply well:

_____ ft NA

Is there evidence of vertical migration of the contaminant plume?

Yes No NA

Statement of Completion & Responsible Party/Consultant Signature Block

The consultant representative acknowledges that this report meets the minimum requirements for a Tier 2 investigation at this petroleum release site, as specified in the Department's Risk-Based Corrective Action (RBCA) at Petroleum Release Sites: Tier 1/Tier 2 Assessments and Reports Guidance Document. Any procedures that differ from the guidance document specifications are noted in the report, were approved by the Department and are accompanied by appropriate documentation. The responsible party acknowledges that they have read (or discussed with their consultant), this site investigation report and are aware of their responsibility for the timely submission to the Department.

Consultant Representative Signature

Date

Responsible Party Signature

Date

ADDITIONAL NOTES

Recommended attachments: None.

FACILITY NAME:

CONSULTANT:

NDEQ SPILL NO.:

NDEQ IIS NO.:

COMPLETION DATE: 00-Jan-00

PREPARED BY:

INSTRUCTIONS FOR INVESTIGATION NARRATIVE

Note: The reporter may use a format of their choosing for the following narrative information, with the provision that all the minimum information requirements listed below, as it pertains to the exposure pathways investigated, are provided under the following headings and in the order outlined. Place the narrative behind a copy of this investigation form in the Tier 1 report.

- I. Brief history of any abatement/remedial actions taken prior to initiating the Tier 2 investigation
- II. Summary of site characteristics
 - A. Site Location
 - B. General site topography, geology, and hydrogeology
- III. Summary of drilling activities
 - A. Date/method/equipment
 - B. Drilling order of boreholes
 - C. Drilling complications (e.g., auger failure or refusal, site recently modified), if any
 - D. Description of materials drilled through and evidence of contamination
 - E. Monitoring well installation
 - depth of wells
 - filter pack and grout materials
 - screened interval
 - type of well head protection
 - well development methodology, duration, estimated water removed
 - other information
 - F. Monitoring well location information
 - nature & location of permanent benchmark to which wells are referenced (designate on site map)
 - method (e.g., stadia, measuring wheel, tape) and measurements (in tabular format) used to reference wells to benchmark
 - G. Other information related to drilling activities (e.g., start/stop times for drilling & well installation)
- IV. Direct push technologies
 - A. Date/method/equipment
 - B. Order of probe locations
 - C. Description of materials drilled through and evidence of contamination
 - D. Other information related to direct push activities (e.g., start/stop times, media investigated)
- V. Summary of sampling activities
 - A. Soil sampling
 - method of sample collection
 - method/protocol used for head space analysis
 - method/protocol used for laboratory sample preparation
 - B. Ground water sampling
 - purging method/protocol/criteria (includes rationale for not purging, if applicable)
 - sample collection method/protocol
 - order of well sampling (Note: sample least contaminated to most contaminated)
 - C. Drinking water supply well/system sampling
 - location of sampling point (e.g., directly from well, outdoor tap, indoor tap)
 - purging method/protocol/criteria
 - sample collection method/protocol
 - D. Soil vapor sampling
 - sample point installation (e.g., probe rod, vapor monitoring well)
 - purging method/protocol/criteria
 - sample collection method/protocol
 - E. QA/QC considerations
 - steps taken to limit cross-contamination between sampling locations
 - number/type/location of duplicates/blanks
 - decontamination protocol and other measures taken to minimize cross-contamination
- VI. Other information
 - A. Rationale for variances from approved work plan or RBCA guidance document
 - B. Contact information (i.e., names, phone numbers, affiliations) for people providing information gathered during investigation

FACILITY NAME:	CONSULTANT:
-----------------------	--------------------

NDEQ SPILL NO.:	NDEQ IIS NO.:
------------------------	----------------------

COMPLETION DATE:	PREPARED BY:
-------------------------	---------------------

SITE STRATIGRAPHY AND HYDROGEOLOGY (Based on Tier 2 investigation)

STRATIGRAPHY OF THE SITE

Depth [feet]	Unified Soil Classification	Type of Soil
Predominant soil type:		

Depth [feet]	Type of Bedrock & Geological Formation (where applicable) (discuss rock properties and features, e.g. fractures)
--------------	---

HYDROGEOLOGY OF THE IMPACTED SATURATED ZONE
--

Type of aquifer? (Justify under "Additional Notes")	<input type="checkbox"/> Confined	<input type="checkbox"/> Unconfined	<input type="checkbox"/> Perched
Range of ground water fluctuation, (if known):	_____ ft	Source:	_____
Average depth to water table/static water level:	_____ ft		
Flow direction:	_____		
Hydraulic gradient (i):	_____ ft/ft	MWs used:	_____
Hydraulic conductivity (K):	_____ ft/day	for:	_____
Porosity (n):	_____		
Seepage velocity (K x i/n) [calculated]:	_____ ft/day	_____ cm/year	

ADDITIONAL NOTES

Recommended attachments: Relevant cross-sections, soil boring logs, and laboratory/field sheets providing vadose zone characteristics.

FACILITY NAME:	CONSULTANT:
-----------------------	--------------------

NDEQ SPILL NO.:	NDEQ IIS NO.:
------------------------	----------------------

COMPLETION DATE:	PREPARED BY:
-------------------------	---------------------

SITE-SPECIFIC VADOSE ZONE PARAMETERS (Based on Tier 2 investigation)

DRY BULK DENSITY

<u>Unit Interval [ft bgl]</u>	<u>Sediment Type</u>	<u>Value [g/cm³]</u>	<u>ASTM Test Method</u>

POROSITY

NOTE: Values for porosity may be estimated using Table 6-2 of the NDEQ RBCA Guidance Document.

<u>Unit Interval [ft bgl]</u>	<u>Sediment Type</u>	<u>Value [cm³/cm³]</u>

VOLUMETRIC WATER CONTENT

<u>Unit Interval [ft bgl]</u>	<u>Sediment Type</u>	<u>Value [cm³/cm³]</u>	<u>ASTM Test Method</u>

FRACTIONAL ORGANIC CARBON CONTENT
--

<u>Unit Interval (ft bgl)</u>	<u>Sediment Type</u>	<u>Value [g-C/g-soil]</u>	<u>ASTM Test Method</u>

ADDITIONAL NOTES

--

Recommended attachments: Relevant cross-sections, soil boring logs, and laboratory/field sheets providing vadose zone characteristics.

NDEQ RBCA TIER 2 REPORT	Tier 2 Investigation Form - 5
--------------------------------	--------------------------------------

FACILITY NAME:	NDEQ SPILL NO.:	NDEQ IIS NO.:
CONSULTANT:	COMPLETION DATE:	PREPARED BY:

ANALYTICAL DATA SUMMARY FOR SUBSURFACE SOIL (Based on Tier 2 investigation; soil sample depth greater than 3 feet bgl. All concentrations in mg/kg)

NOT APPLICABLE FOR THIS SITE

MW / SB No.	Sampling Date	Sample Depth (ft)											Arithmetic Average	Maximum	Ratio (Maximum/Arithmetic Average) *	
VOLATILE ORGANIC CHEMICALS ANALYSES																
Benzene																
Toluene																
Ethylbenzene																
Xylenes (mixed)																
n-Hexane																
Methyl-tert-butyl-ether (MTBE)																
Naphthalene																
TOTAL EXTRACTABLE HYDROCARBONS ANALYSES																
TEH (as diesel)																
TEH (as waste oil)																
TEH (as kerosene)																
TEH as																
TEH as																
TEH as																
OTHER ANALYTES																

NOTE:
 Provide any laboratory analytical datasheets not previously submitted to the Department. Add additional sheets as needed. Page 1 of _____
 Non-detects can be expressed as ND, BDL, etc.
 * : If the ratio is high (for example >10) there may be a "hot spot" and additional investigation/evaluation may be warranted. In such circumstances, contact the Department.

Recommended Attachments : Site map showing location(s) of subsurface soil sample(s), chemical concentration maps, laboratory analysis report(s), chain of custody, and boring logs.

NDEQ RBCA TIER 2 REPORT	Tier 2 Investigation Form - 6a
--------------------------------	---------------------------------------

FACILITY NAME:	NDEQ SPILL NO.:	NDEQ IIS NO.:
-----------------------	------------------------	----------------------

CONSULTANT:	COMPLETION DATE:	PREPARED BY:
--------------------	-------------------------	---------------------

ANALYTICAL DATA SUMMARY FOR WATER QA/QC SAMPLES (Based on Tier 2 investigation; All concentrations in mg/L)
<input type="checkbox"/> NOT APPLICABLE FOR THIS SITE

Type of QA/QC Water Sample	Blind Duplicates			Field Blanks			Trip Blanks		
Sample Designation									
Sample Date									
Field Blank Exposure Time (min)									

VOLATILE ORGANIC CHEMICALS ANALYSES
--

Benzene									
Toluene									
Ethylbenzene									
Xylenes									
n-Hexane									
Methyl-tert-butyl-ether (MTBE)									
Naphthalene									

TOTAL EXTRACTABLE HYDROCARBONS ANALYSES
--

TEH (as diesel)									
TEH (as waste oil)									
TEH (as kerosene)									
TEH as									
TEH as									
TEH as									

OTHER ANALYTES

TEMPERATURE BLANKS	Cooler ID	Pre-Delivery Temp. (°C)	Laboratory Temp. (°C)	Cooler ID	Pre-Delivery Temp. (°C)	Laboratory Temp. (°C)	Cooler ID	Pre-Delivery Temp. (°C)	Laboratory Temp. (°C)

NOTE: Provide any laboratory analytical datasheets not previously submitted to the Department. Add additional sheets as needed.

Recommended Attachment: Laboratory analysis report(s) and chain of custody.

NDEQ RBCA TIER 2 REPORT

Tier 2 Investigation Form - 7

FACILITY NAME:	NDEQ SPILL NO.:	NDEQ IIS NO.:
CONSULTANT:	COMPLETION DATE:	PREPARED BY:

ANALYTICAL DATA SUMMARY FOR SOIL GAS SAMPLES (Based on Tier 2 investigation; All concentrations in mg/m³)

NOT APPLICABLE FOR THIS SITE

Sample No.										Arithmetic Average	Maximum	Ratio (Maximum/Arithmetic Average) *
Sampling Date												
Sample Depth (ft)												
VOLATILE ORGANIC CHEMICALS ANALYSES												
Benzene												
Toluene												
Ethylbenzene												
Xylenes												
n-Hexane												
Methyl-tert-butyl-ether (MTBE)												
Naphthalene												
TOTAL EXTRACTABLE HYDROCARBONS ANALYSES												
TEH (as diesel)												
TEH (as waste oil)												
TEH (as kerosene)												
TEH as												
TEH as												
TEH as												
OTHER ANALYTES												

NOTE:

Provide any laboratory analytical datasheets not previously submitted to the Department.

Page 1 of

Non-detects can be expressed as ND, BDL, etc.

* : If the ratio is high (for example >10) there may be a "hot spot" and additional investigation/evaluation may be warranted. In such circumstances, contact the Department.

Recommended Attachments: Site map showing location(s) of soil gas sample(s), chemical concentration maps, laboratory analysis report(s), chain of custody, and boring logs.

**NDEQ Petroleum Remediation Section
RBCA Guidance Document**

**APPENDIX D:
TARGET LEVEL DEFAULT DATA**

Table D-1. PHYSICAL/CHEMICAL PROPERTIES OF CHEMICALS OF CONCERN

Constituent	Molecular Weight ¹	K_{oc} ² (mg/g)/(mg/mL)	K_d ⁴ (mg/g)/(mg/mL)	H ² L-water/L-air	D_i ² cm ² /s	D_w ² cm ² /s	S ² mg/L	Half Life ² d	Decay Rate (λ) ⁴ d ⁻¹	C_{POE} ³ mg/L
Benzene	78	3.80E+01	$K_{oc} * f_{oc}$	2.20E-01	9.30E-02	1.10E-05	1.75E+03	7.30E+03	9.49E-05	5.00E-03
Toluene	92	1.35E+02	$K_{oc} * f_{oc}$	2.60E-01	8.50E-02	9.40E-06	5.35E+02	6.30E+02	1.10E-03	1.00E+00
Ethylbenzene	106	9.55E+01	$K_{oc} * f_{oc}$	3.20E-01	7.60E-02	8.50E-06	1.52E+02	2.28E+03	3.04E-04	7.00E-01
Xylene (mixed)	106	2.40E+02	$K_{oc} * f_{oc}$	2.90E-01	7.20E-02	8.50E-06	1.98E+02	3.65E+03	1.90E-04	1.00E+01
Benzo(a)pyrene	252	3.89E+05	$K_{oc} * f_{oc}$	5.80E-08	5.00E-02	5.80E-06	3.80E-03	1.06E+04	6.55E-05	2.00E-04
Naphthalene	128	1.30E+03	$K_{oc} * f_{oc}$	4.90E-02	7.20E-02	9.40E-06	3.10E+01	2.58E+03	2.69E-04	2.00E-02
Pyrene	202	3.80E+04	$K_{oc} * f_{oc}$	5.10E-06	5.70E-02	4.56E-06	1.32E-01	3.65E+03	1.90E-04	2.00E-02
n-Hexane	86	4.79E+02	$K_{oc} * f_{oc}$	3.14E+01	2.00E-01	7.77E-06	1.30E+01	3.65E+03	1.90E-04	4.00E+00
MTBE	88	1.23E+01	$K_{oc} * f_{oc}$	2.20E-02	8.06E-02	6.10E-06	4.80E+04	1.00E+04	6.93E-05	2.00E-02
TEH as diesel										
TEH as waste oil										

1 : MERCK Index

2 : Standard guide for risk-based corrective action applied at petroleum release sites, ASTM 1739 -95

3 : Nebraska Department of Environmental Quality

4: Calculated

K_{oc} : Carbon-water partition coefficient [(mg/g-carbon)/(mg/mL water)]

K_d : Soil-water partition coefficient [(mg/g-soil)/(mg/mL water)]

H : Dimensionless Henry's law coefficient [L-water/L-air]

D_i : Diffusion coefficient in air [cm²/s]

D_w : Diffusion coefficient in water [cm²/s]

S : Pure component solubility in water [mg/L]

C_{POE} : Allowable groundwater receptor concentration (concentration at the point of exposure) [mg/L]

Table D-2. TOXICITY PARAMETERS OF CONSTITUENTS OF CONCERN

Chemical of Concern	Slope Factor		Reference Dose		Oral RA Factor (RAF _o)	Dermal RA Factor (RAF _d)
	Oral (SF _o) [kg-day/mg]	Inh. (SF _i) [kg-day/mg]	Oral (RfD _o) (mg/kg-day)	Inh. (RfD _i) (mg/kg-day)		
Benzene	0.055 ^a	0.0273 ^a	0.003 ^b	0.0017 ^b	1	0.5
Toluene	NA	NA	0.2	0.114	1	0.5
Ethylbenzene	NA	NA	0.1	0.29	1	0.5
Xylene (mixed)	NA	NA	2	0.2	1	0.5
Benzo(a)pyrene	7.3	3.1	NA	NA	1	0.05
Naphthalene	NA	NA	0.02	0.00086	1	0.05
Pyrene	NA	NA	0.03	0.03	1	0.05
n-Hexane	NA	NA	0.06	0.057	1	0.5
MTBE	0.0018	0.0018	NA	NA	1	0.5
TEH as diesel	NA	NA	NA	NA	NA	NA
TEH as waste oil	NA	NA	NA	NA	NA	NA

Toxicity parameters revision date: February 2002

Notes:

^a Value provided is most conservative of range provided in USEPA IRIS database.

^b Reference doses for benzene applicable for addressing additivity concerns for BTEX compounds.

NA: Not applicable

Table D-3. APPLICABLE EXPOSURE FACTORS

Parameter	Symbol	Unit	Value	Parameter	Symbol	Unit	Value
Averaging Time for Carcinogen	ATc	year	70				
Averaging Time for Non-Carcinogen	ATn	year	=ED				
Body Weight:				Indoor Inhalation Rate:			
Resident Child	BW	kg	15	Resident Child	IRa	m ³ /day	15
Resident Adult	BW	kg	70	Resident Adult	IRai	m ³ /day	20
Commercial Worker	BW	kg	70	Commercial Worker	IRa	m ³ /day	20
Exposure Duration:				Hourly Outdoor Inhalation Rate:			
Resident Child	ED	year	6	Resident Child	IRo	m ³ /hr	1
Resident Adult	ED	year	30	Resident Adult	IRo	m ³ /hr	0.84
Commercial Worker	ED	year	25	Commercial Worker	IRo	m ³ /hr	1.5
Exposure Frequency:				Exposure Time for Hourly Outdoor Inhalation Rate:			
Resident Child	EF	day/year	350	Resident Child	Eto	hr/day	10
Resident Adult	EF	day/year	350	Resident Adult	Eto	hr/day	10
Commercial Worker	EF	day/year	250	Commercial Worker	Eto	hr/day	10
Soil Ingestion Rate:				Outdoor Inhalation Rate:			
Resident Child	IRs	mg/day	200	Resident Child	IRa	m ³ /day	20
Resident Adult	IRs	mg/day	50	Resident Adult	IRo	m ³ /day	20
Commercial Worker	IRs	mg/day	50	Commercial Worker	IRa	m ³ /day	20
Groundwater Ingestion Rate:				Skin Surface Area:			
Resident Child	IRw	L/day	1	Resident Child	SA	cm ² /day	2500
Resident Adult	IRw	L/day	2	Resident Adult	SA	cm ² /day	3160
Commercial Worker	IRw	L/day	1	Commercial Worker	SA	cm ² /day	5000
Hourly Indoor Inhalation Rate:				Soil to Skin Adherence Factor:			
Resident Child	IRi	m ³ /hr	0.417	Resident Child	M	mg/cm ²	0.5
Resident Adult	IRi	m ³ /hr	0.84	Resident Adult	M	mg/cm ²	0.5
Commercial Worker	IRi	m ³ /hr	1.5	Commercial Worker	M	mg/cm ²	0.5
Exposure Time for Hourly Indoor Inhalation Rate:				Target Risk Limit			
Resident Child	Eti	hr/day	24	TR	--		variable ¹
Resident Adult	Eti	hr/day	24	Target Hazard Index for BTEX			
Commercial Worker	Eti	hr/day	10	THI	--		0.25
				Target Hazard Quotient (other COCs)			
				THQ	--		1
				¹ May be 1.00E10-6 or 1.00E10-5. See section 7.3.1.			

Table D-4. FATE AND TRANSPORT PARAMETERS

Parameter	Symbol	Unit	Tier 1 Default Value		Tier 2 Value
			Hydrogeology 1 (Silt & Clays)	Hydrogeology 2 (Sands)	
SOIL PARAMETERS:					
Soil Source Length Parallel to Wind Direction	W_a	cm	914	914	914
Depth to Contaminants in Subsurface Soil	L_s	cm	Variable		Site-Specific
Lower Depth of Surface Soil Zone	d	cm	91.4	91.4	91.4
Thickness of Capillary Fringe	h_{cap}	cm	Not Applicable for Tier 1		Site-Specific
Thickness of Vadose Zone	h_v	cm	Variable		Site-Specific
Unsaturated Zone Dry Soil Bulk Density	ρ_s	g/cm^3	1.7	1.7	Site-Specific
Fractional Organic Carbon Content in Vadose Zone	f_{oc}	g-C/g-soil	0.01	0.005	Site-Specific
Total Soil Porosity in Impacted Zone	θ_T	cm^3/cm^3 -soil	0.35	0.30	Site-Specific
Volumetric Water Content in Capillary Fringe	θ_{wcap}	cm^3/cm^3	Not Applicable for Tier 1		Site-Specific
Volumetric Water Content in Vadose Zone	θ_{ws}	cm^3/cm^3	0.1	0.1	Site-Specific
Volumetric Air Content in Capillary Fringe	θ_{acap}	cm^3/cm^3	Not Applicable for Tier 1		Site-Specific
Volumetric Air Content in Vadose Zone	θ_{as}	cm^3/cm^3	0.2	0.25	Site-Specific
SOIL VAPOR PARAMETERS:					
Depth to Soil Vapor Sample	$L_{s,v}$	cm	Not Applicable for Tier 1		Site-Specific
GROUND WATER PARAMETERS:					
Depth to Ground Water	L_{gw}	cm	Variable		Site-Specific
Width of GW Source Perpendicular to the GW Flow Direction	W_y	cm	914	914	914
Length of GW Source Parallel to the GW Flow Direction	W_x	cm	914	914	914
Soil Bulk Density in the Saturated Zone	ρ_{ss}	g/cm^3	1.7	1.7	Site-Specific
Fractional Organic Carbon Content in Saturated Zone	f_{ocs}	g-C/g-soil	0.01	0.005	Site-Specific
Total Soil Porosity in Saturated Zone	θ_{Ts}	cm^3/cm^3 -soil	0.3	0.35	Site-Specific
Hydraulic Conductivity in the Saturated Zone	K	cm/year	22250	2225000	Site-Specific
Hydraulic Gradient	i	--	0.005	0.005	Site-Specific
Ground Water Darcy Velocity	U_{gw}	cm/year	111.25	11125	Site-Specific
Ground Water Mixing Zone Thickness	δ_{gw}	cm	152.4	152.4	152.4
Infiltration Rate	I	cm/year	3.8	7.6	3.8 or 7.6
AMBIENT AIR PARAMETERS					
Breathing Zone Height	δ_a	cm	200	200	200
Wind Speed within the Breathing Zone	U_a	cm/s	225	225	225
ENCLOSED SPACE PARAMETERS					
Enclosed Space Air Exchange Rate					
Residential	N	$(day)^{-1}$	12	12	12
Commercial	N	$(day)^{-1}$	20	20	20
Height of Enclosed Space (Residential & Commercial)	h	cm	240	240	240
Fraction of Cracks in foundation through which diffusion occurs					
(Residential and Commercial)	f	cm^2/cm^2	0.001	0.001	0.001
Particulate Emission Rate (Residential & Commercial)	P_e	g/cm^2s	6.90E-14	6.90E-14	6.90E-14
Averaging Time for Vapor Flux					
Resident Child	τ	s	1.89E+08	1.89E+08	1.89E+08
Resident Adult	τ	s	9.46E+08	9.46E+08	9.46E+08
Commercial Worker	τ	s	7.88E+08	7.88E+08	7.88E+08

**NDEQ Petroleum Remediation Section
RBCA Guidance Document**

**APPENDIX E:
FATE & TRANSPORT EQUATIONS**

Table E-1. Allowable Ground Water Concentrations for a POE

For a RAC-1 release, the allowable ground water concentration at a point of exposure (C_{poe}) is equal to the COC-specific MCL or some other standard selected by the Department for a COC not having an MCL.

For a RAC-2 release, C_{poe} is equal to a calculated risk-based target level for water ingestion based on the following:

<u>Carcinogenic effects</u>	<u>Non-carcinogenic effects</u>
$RBTL_{gw} = \frac{TR \times BW \times AT_c \times 365}{IR_w \times ED \times EF \times SF_o}$	$RBTL_{gw} = \frac{THQ \times BW \times AT_{nc} \times 365 \times RfD_o}{IR_w \times ED \times EF}$

where:

- RBTL_{gw} = Risk-based target level for ground water ingestion [mg/L]
- TR = Target risk or the increased chance of developing cancer over a lifetime due to exposure to a chemical of concern [-]
- THQ = Target hazard quotient for individual non-carcinogenic constituents [-]
- BW = Body weight [kg]
- AT_c = Averaging time for a carcinogen [years]
- AT_{nc} = Averaging time for a non-carcinogen [years]
- IR_w = Water ingestion rate [L/day]
- ED = Exposure duration [years]
- EF = Exposure frequency [days/year]
- SF_o = Chemical-specific oral cancer slope or potency factor [mg/(kg-day)]⁻¹
- RfD_o = Chemical-specific oral reference dose [mg/(kg-day)]

Table E-2. Ground Water Concentration at a Source and a POC Protective of Drinking Water

$C_{\text{gw,source}} = C_{\text{poe}} \times CRF_{\text{sat,poe}}$	
$C_{\text{gw,poc}} = C_{\text{poe}} \times \frac{CRF_{\text{sat,poe}}}{CRF_{\text{sat,poc}}}$	
<p>where:</p>	
$C_{\text{gw,source}}$	= RBSL calculated in the source area [mg/L]
$CRF_{\text{sat,poe}}$	= Concentration reduction factor in the saturated zone between a source area and a point of exposure [(mg/L)/(mg/L)]
$CRF_{\text{sat,poc}}$	= Concentration reduction factor in the saturated zone between a source area and a point of compliance [(mg/L)/(mg/L)]
C_{poe}	= Allowable contaminant concentration at the point of exposure [mg/L]

The CRF_{sat} is estimated using a simplified version of **Domenico's model** that assumes (i) infinite source, (ii) uniform, one-dimensional flow, (iii) first order biodecay, and (iv) the receptor located directly down gradient from the source. The specific form of Domenico's model used is:

$$\frac{C(x)}{C_o} = \exp \left[\frac{x}{2\alpha_x} \left[1 - \sqrt{1 + \frac{4\lambda\alpha_x}{v}} \right] \right] \times \text{erf} \left[\frac{W_y}{4\sqrt{\alpha_y x}} \right] \times \text{erf} \left[\frac{\delta_{\text{gw}}}{2\sqrt{\alpha_z x}} \right]$$

where:

- C = Dissolved-phase concentration [mg/L]
- C_o = Dissolved-phase concentration at the source (at $x=y=z=0$) [mg/L]
- v = Retarded seepage velocity for a chemical [cm/day]
= Darcy Velocity/(Retardation Factor x Total Porosity)
- λ = Overall first order decay rate [1/day]
- α_x = Longitudinal dispersivity [cm] = $x/10$
- α_y = Lateral dispersivity [cm] = $x/30$
- α_z = Vertical dispersivity [cm] = $x/100$
- x, y, z = Spatial coordinates [cm]
- x = Distance along the center line from the downgradient edge of the dissolved-plume source zone or source well [cm]
- W_y = Width of source area perpendicular to ground water flow [cm]
- δ_{gw} = Ground water mixing zone thickness [cm]

$$v = \frac{K \times i}{R \times \theta_{TS}}$$

Retarded seepage velocity,

where:

- K = Hydraulic conductivity [cm/year]
i = Hydraulic gradient [--]
R = Retardation factor [--]
 θ_{TS} = Total porosity in the saturated zone [cm³ voids/cm³ soil]

Retardation factor,
$$R = 1 + \frac{\rho_{ss} \times K_{ds}}{\theta_{TS}}$$

where:

- ρ_{ss} = Dry bulk density of soil in the saturated zone [g/cm³]
 K_{ds} = Soil-water partition coefficient in the saturated zone [cm³ water/g soil] = $f_{ocs} \times K_{oc}$
 f_{ocs} = Fractional organic carbon content in the saturated zone soil [g C/g soil]
 K_{oc} = Carbon-water partition coefficient [cm³-water/g-C]
 θ_{TS} = Total porosity in the saturated zone [cm³ voids/cm³ soil]

If a particular chemical is assumed not to biodecay (i.e., $\lambda=0$), $\frac{C(x)}{C_o}$ is equal to the result of the error function.

Please note that the CRF_{sat} is actually equal to $\frac{C_o}{C(x)}$.

Source: *Domenico, P.A. and F.W. Schwartz, 1990, Physical and Chemical Hydrogeology. John Wiley and Sons, NY, 824 p. (Eqn. 17.21)*

Table E-3. Soil Concentration Protective of Drinking Water

$$C_{\text{soil}} = C_{\text{poe}} \times \text{CRF}_{\text{sat,poe}} \times \text{CRF}_{\text{mix}} \times \text{CRF}_{\text{unsat}} \times \text{ECF}$$

where:

- C_{soil} = Allowable source soil concentration [mg/kg]
- C_{poe} = Allowable ground water concentration at the point of exposure [mg/L]
- $\text{CRF}_{\text{sat,poe}}$ = Concentration reduction factor in the saturated zone [(mg/L)/(mg/L)]
- CRF_{mix} = Concentration reduction factor in the mixing zone [(mg/L)/(mg/L)]
- $\text{CRF}_{\text{unsat}}$ = Concentration reduction factor in the unsaturated zone [(mg/L)/(mg/L)]
- ECF = Equilibrium conversion factor [(mg/kg soil)/(mg/L water)]

$$\text{CRF}_{\text{mix}} = 1 + \frac{U_{\text{gw}} \times \delta_{\text{gw}}}{IW_x}$$

where:

- U_{gw} = Ground water Darcy velocity [cm/year]
- = Hydraulic conductivity [cm/year] x Hydraulic gradient [--]
- δ_{gw} = Ground water mixing zone thickness [cm]
- I = Infiltration rate of water through soil [cm/year]
- W_x = Length of source area parallel to ground water flow [cm]

$\text{CRF}_{\text{unsat}}$ is empirically estimated in Tier 1.

- $\text{CRF}_{\text{unsat}} = 1$ for depth to ground water <50 feet
- $\text{CRF}_{\text{unsat}} = 2$ for depth to ground water >50 feet

$$\text{ECF} = \frac{\rho_s \times K_d + \theta_{\text{ws}} + \theta_{\text{as}} \times H}{\rho_s}$$

where:

- ρ_s = Dry bulk density of soil [g/cm³]
- K_d = Soil-water partition coefficient [cm³ water/g soil] = $f_{\text{oc}} \times K_{\text{oc}}$
- f_{oc} = Fractional organic carbon content [g C/g soil]
- K_{oc} = Carbon-water partition coefficient [cm³ water/g C]
- θ_{ws} = Volumetric water content in the vadose zone [cm³/cm³]
- θ_{as} = Volumetric air content in the soil [cm³/cm³]
- H = Henry's Law coefficient [(mg/L water)/(mg/L air)]

**Table E-4. Allowable Enclosed Space Breathing Zone COC Concentrations
for Indoor Inhalation**

To calculate allowable subsurface soil and ground water RBSLs protective of the enclosed space inhalation pathways of concern, target levels for contaminant concentrations within the enclosed space breathing zone must first be determined. These target levels are determined based on the following:

Carcinogenic effects

$$RBTL_{ai} = \frac{TR \times BW \times AT_c \times 365}{IR_i \times ET_i \times ED \times EF \times SF_i}$$

Non-carcinogenic effects

$$RBTL_{ai} = \frac{THQ \times BW \times AT_{nc} \times 365 \times RfD_i}{IR_i \times ET_i \times ED \times EF}$$

where:

- RBTL_{ai} = Risk-based target level for indoor air [mg/m³]
- TR = Target risk or the increased chance of developing cancer over a lifetime due to exposure to a chemical of concern [-]
- THQ = Target hazard quotient for individual non-carcinogenic constituents [-]
- BW = Body weight [kg]
- AT_c = Averaging time for a carcinogen [years]
- AT_{nc} = Averaging time for a non-carcinogen [years]
- IR_i = Indoor inhalation rate [m³/hour]
- ET_i = Exposure time for indoors inhalation [hours/day]
- ED = Exposure duration [years]
- EF = Exposure frequency [days/year]
- SF_i = Chemical-specific inhalation cancer slope or potency factor [mg/(kg-day)]⁻¹
- RfD_i = Chemical-specific inhalation reference dose [mg/(kg-day)]

Table E-5. Soil Vapor Concentrations Protective of Indoor Inhalation

Once $RBTL_{ai}$ has been determined, this value is used to calculate an allowable soil vapor gas concentration outside the enclosed, indoor space in source zone soils, at the soil-vapor sampling point, and above the ground water table using the following relationships:

$$C_{v,s} = RBTL_{ai} \times 10^{-3} \times \left[\frac{h \times N \times L_s}{f \times 86400 \times D_s^{eff}} + 1 \right]$$

$$C_{v,v} = RBTL_{ai} \times 10^{-3} \times \left[\frac{h \times N \times L_{s,v}}{f \times 86400 \times D_s^{eff}} + 1 \right]$$

$$C_{v,gw} = RBTL_{ai} \times 10^{-3} \times \left[\frac{h \times N \times L_{gw}}{f \times 86400 \times D_w^{eff}} + 1 \right]$$

where:

- $C_{v,s}$ = Vapor concentration in subsurface source soil [mg/L]
- $C_{v,v}$ = Vapor concentration in subsurface source soil where the soil-vapor sample is collected [mg/L]
- $C_{v,gw}$ = Vapor concentration above the ground water table [mg/L]
- h = Height of the indoor space [cm]
- N = Volume of air changes per day [1/day] Note: 86400 converts days to seconds.
- L_s = Depth to chemical in soil [cm]
- $L_{s,v}$ = Depth to soil-vapor sampling point [cm]
- L_{gw} = Depth to the ground water table [cm]
- f = Fraction of the floor area through which diffusion occurs [-]
- D_s^{eff} = Chemical-specific effective diffusion coefficient in vadose zone soils [cm^2/s]
- D_w^{eff} = Chemical-specific effective diffusion coefficient between the ground water table and a structure [cm^2/s]
- $RBTL_{ai}$ = Risk-based target level for indoor air [mg/m^3]
- Note: 10^{-3} converts mg/m^3 to mg/L.

Table E-6. Calculation of Effective Diffusivities

Chemical-specific effective diffusion coefficients in vadose zone soils, above the ground water table, and in capillary zone soils are calculated using the following relationships:

$$D_s^{eff} = D_a \times \frac{\theta_{as}^{3.33}}{\theta_T^2} + D_w \times \frac{1}{H} \times \frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$D_w^{eff} = \frac{L_{gw}}{\frac{h_{cap}}{D_{cap}^{eff}} + \frac{h_v}{D_s^{eff}}}$$

$$D_{cap}^{eff} = D_a \times \frac{\theta_{acap}^{3.33}}{\theta_T^2} + D_w \times \frac{1}{H} \times \frac{\theta_{wcap}^{3.33}}{\theta_T^2}$$

where:

- D_a = Chemical-specific diffusion coefficient in air [cm²/s]
- D_w = Chemical-specific diffusion coefficient in water [cm²/s]
- D_s^{eff} = Effective diffusivity in vadose zone soils [cm²/s]
- D_w^{eff} = Effective diffusivity above the ground water table [cm²/s]
- D_{cap}^{eff} = Effective diffusivity in capillary zone soils [cm²/s]
- θ_T = Total soil porosity in the impacted zone [cm³/cm³-soil]
- θ_{as} = Volumetric air content in the vadose zone [cm³-air/cm³-soil]
- θ_{ws} = Volumetric water content in the vadose zone [cm³-water/cm³-soil]
- θ_{acap} = Volumetric air content in the capillary zone [cm³-air/cm³-soil]
- θ_{wcap} = Volumetric water content in the capillary zone [cm³-water/cm³-soil]
- H = Henry's Law coefficient [(mg/L water)/(mg/L air)]
- L_{gw} = Depth to the ground water table [cm]
- h_{cap} = Capillary zone thickness [cm]
- h_v = Vadose zone thickness [cm]
- = $L_{gw} - h_{cap}$

Table E-7. Ground Water & Subsurface Soil Contaminant Concentrations Protective of Indoor Inhalation

For ground water:

$$\mathbf{RBSL}_{\text{winh}} = \frac{C_{v,\text{gw}}}{H}$$

where:

- $\mathbf{RBSL}_{\text{winh}}$ = Allowable concentration in ground water protective of indoor inhalation [mg/L]
 $C_{v,\text{gw}}$ = Vapor concentration above the ground water table [mg/L]
 H = Henry's Law coefficient [(mg/L water)/(mg/L air)]

For subsurface soils:

$$\mathbf{RBSL}_{\text{sinh}} = \frac{C_{v,s}}{H} \times ECF$$

where:

- $\mathbf{RBSL}_{\text{sinh}}$ = Allowable concentration in subsurface soil protective of indoor inhalation [mg/kg]
 $C_{v,s}$ = Vapor concentration in soil [mg/L]
 H = Henry's Law coefficient [(mg/L water)/(mg/L air)]
 ECF = Equilibrium conversion factor [(mg/kg soil)/(mg/L water)], as presented in Table 6.

Table E-8. Surface Soil Contaminant Concentrations Protective of Outdoor Inhalation, Dermal Contact, & Ingestion of Vapors and Particulates

RBSLs for contaminated surface soils are determined using the following models:

Carcinogenic effects

RBTL_{SS} =

$$\frac{TR \times BW \times AT_c \times 365}{EF \times ED \times \left[(SF_o \times 10^{-6} \times (IR_s \times RAF_o + SA \times M \times RAF_d)) + (SF_i \times IR_o \times ET_o \times (VF_{ss} + VF_p)) \right]}$$

Non-carcinogenic effects

RBTL_{SS} =

$$\frac{THQ \times BW \times AT_{nc} \times 365}{EF \times ED \times \left[\frac{10^{-6} \times (IR_s \times RAF_o + SA \times M \times RAF_d)}{RfD_o} + \frac{(IR_o \times ET_o \times (VF_{ss} + VF_p))}{RfD_i} \right]}$$

where:

- TR = Target risk or the increased chance of developing cancer over a lifetime due to exposure to a chemical of concern [-]
- THQ = Target hazard quotient for individual non-carcinogenic constituents [-]
- BW = Body weight [kg]
- AT_c = Averaging time for a carcinogen [years]
- AT_{nc} = Averaging time for a non-carcinogen [years]
- ED = Exposure duration [years]
- EF = Exposure frequency [days/year]
- IR_s = Soil ingestion rate [mg/day]
- RAF_o = Oral relative absorption factor [-]
- RAF_d = Dermal relative absorption factor [-]
- SA = Skin surface area [cm²/day]
- M = Soil to skin adherence factor [mg/cm²]
- IR_o = Outdoor inhalation rate [m³/hour]
- ET_o = Exposure time for outdoor inhalation [hour/day]
- SF_o = Chemical-specific oral cancer slope or potency factor [mg/(kg-day)]⁻¹
- SF_i = Chemical-specific inhalation cancer slope or potency factor [mg/(kg-day)]⁻¹
- RfD_o = Chemical-specific oral reference dose [mg/(kg-day)]
- RfD_i = Chemical-specific inhalation reference dose [mg/(kg-day)]
- VF_p = Volatilization factor of particulates [(mg/m³-air)/(mg/kg-soil)]
- VF_{ss} = Volatilization factor from surface soils [(mg/m³-air)/(mg/kg-soil)]
- 10⁻⁶ = Conversion factor [kg/mg]

Table E-9. Calculation of Volatilization Factors from Surface Soil

To calculate $\mathbf{VF_{SS}}$, the volatilization factor from surface soils, use:

$$VF_{SS} = \frac{2 \times W_a \times \rho_s}{U_a \times \delta_a} \times \sqrt{\frac{D_s^{eff} \times H}{\pi \times [\theta_{ws} + (K_d \times \rho_s) + (H \times \theta_{as})] \times \tau}} \times 10^3$$

OR

$$VF_{SS} = \frac{W_a \times \rho_s \times d}{U_a \times \delta_a \times \tau} \times 10^3$$

NOTE: Use the smaller of the two results.

where:

- W_a = Width of source area parallel to wind flow direction [cm]
- ρ_s = Dry soil bulk density [g-soil/cm³-soil]
- U_a = Wind speed within breathing zone [cm/s]
- δ_a = Breathing zone height [cm]
- D_s^{eff} = Effective diffusion coefficient in soil based on vapor-phase concentration [cm²/s]
- H = Henry's Law coefficient [(mg/L water)/(mg/L air)]
- θ_{as} = Volumetric air content in capillary fringe soils [cm³-air/cm³-soil]
- θ_{ws} = Volumetric water content in capillary fringe soils [cm³-water/cm³-soil]
- K_d = Soil-water partition coefficient [cm³ water/g soil] = $f_{oc} \times K_{oc}$
- f_{oc} = Fractional organic carbon content [g C/g soil]
- K_{oc} = Carbon-water partition coefficient [cm³-water/g-C]
- τ = Averaging time for vapor flux [s] = ED(yr) X 365(day/yr) X 86400(sec/day)
- d = Depth to base of surficial soil zone [cm]
- 10^3 = Conversion factor [(cm³-kg)/(m³-g)]

To calculate $\mathbf{VF_p}$, the volatilization factor of particulates, use:

$$VF_p = \frac{P_e \times W_a}{U_a \times \delta_a} \times 10^3$$

where:

- P_e = Particulate emission rate [g-soil/cm²-sec]
- Other elements as provided above.

Table E-10. Soil Saturation Level

In some instances, the calculated RBSL for an exposure pathway of concern involving surface or subsurface soils may be greater than the maximum contaminant concentration that could be expected for the specified exposure scenario, even if free phase product is present in the soil. The soil concentration at which equilibrated vapor and dissolved pore-water phases become saturated, C_s^{sat} , is described by the following:

$$C_s^{sat} = \frac{S}{\rho_s} \times [H \times \theta_{as} + \theta_{ws} + K_d \times \rho_s]$$

where:

- S = Pure component solubility in water [mg/L-water]
- ρ_s = Dry soil bulk density [g-soil/cm³-soil]
- H = Henry's Law coefficient [(mg/L water)/(mg/L air)]
- θ_{as} = Volumetric air content in the vadose zone [cm³-air/cm³-soil]
- θ_{ws} = Volumetric water content in the vadose zone [cm³-water/cm³-soil]
- K_d = Soil-water partition coefficient [cm³ water/g soil] = $f_{oc} \times K_{oc}$
- f_{oc} = Fractional organic carbon content [g C/g soil]
- K_{oc} = Carbon-water partition coefficient [cm³ water/g C]

Table E-11. Saturated Vapor Concentration

$$C_v^{sat} = \frac{P_v \times MW \times 10^3}{R \times T}$$

where:

- C_v^{sat} = Saturated vapor concentration [mg/L-air]
- P_v = Saturated Vapor Pressure [atm]
- MW = Molecular Weight [g/g-mol]
- R = Ideal Gas Constant [L-atm/g-mol-K]
- T = Temperature [K]
- 10^3 = Conversion Factor [mg/g]

**NDEQ Petroleum Remediation Section
RBCA Guidance Document**

**APPENDIX F:
ASSOCIATED STATE AGENCY & OTHER AUTHORITIES CONTACT LIST**

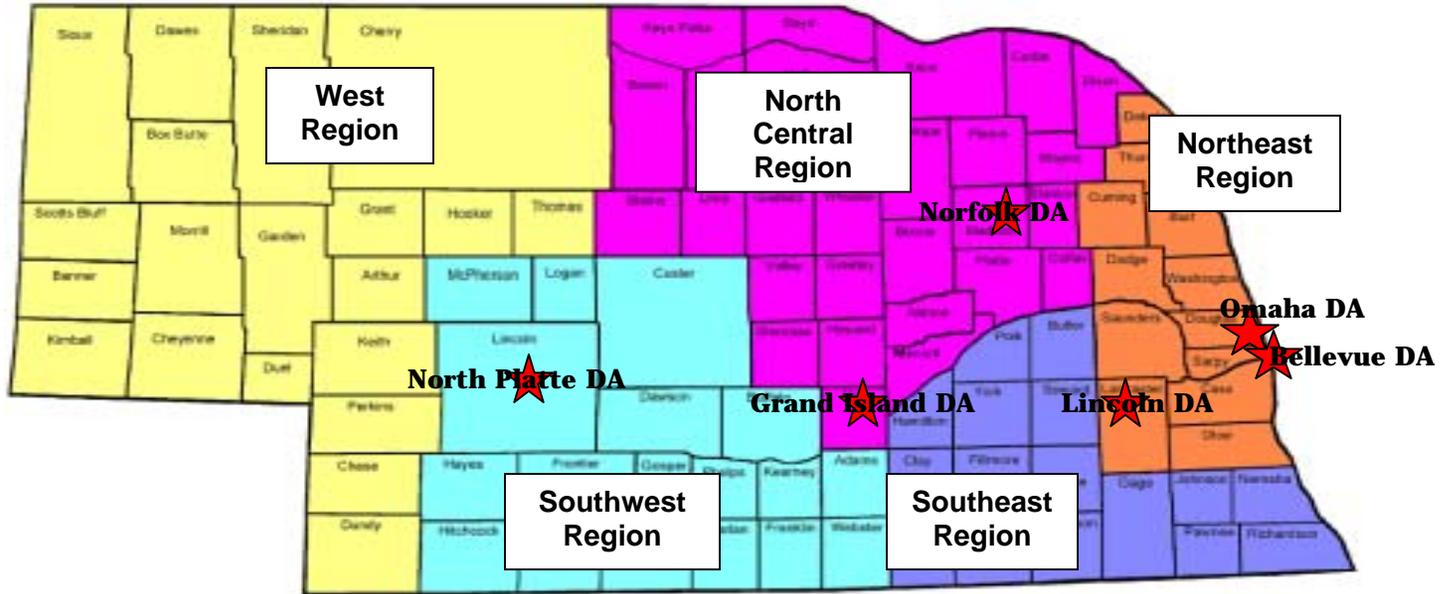
Table F-1. Associated State Agency and Other Authorities Contact List

Authority	Area of Concern	Contact Information
Nebraska Department of Environmental Quality		
Petroleum Remediation Section	Petroleum release investigations and remedial actions	402/471-2186
Waste Management Section	Petroleum contaminated soils disposal	402/471-4210
NPDES Permits Unit	NPDES discharge permitting	402/471-2186
Permitting Section (Air Quality)	Construction permitting for SVE or air stripping remedial systems	402/471-2189
General NDEQ	Reporting of spills per Neb. Title 126	402/471-2186 402/471-4545 (after hours, weekends, and holidays)
Nebraska State Fire Marshal		
Fuels Division	UST system installation, removals, inspections; fire/explosion threats	402/471-9465 (see attachment for SFM District Inspectors & Delegated Authorities)
Nebraska Health & Human Services System		
Regulation & Licensure - Environmental Health Services	Water well construction regulations	402/471-3121
Nebraska Department of Natural Resources		
Water Administration Division	Monitoring well registration requirements, registered well locations	402/471-2363
Nebraska Department of Roads		
Right of Way Division	Drilling on state highway right-of-way	402/479-4761
Natural Resource District Offices	Water production well permitting in Ground Water Management Areas	See attached sheet
United States Environmental Protection Agency		
Region VII Spill Prevention, Containment & Countermeasures (SPCC)	Petroleum storage secondary containment	913/551-7247
Region VII Spill Line	Spill reporting	913/281-0991
National Response Center	Reporting of petroleum spills >10,000 gallons to land or any quantity to navigable waters	800/424-8802



Figure F-1. NEBRASKA STATE FIRE MARSHAL Flammable Liquid Storage Tanks DEPUTY AREA MAP & DELEGATED AUTHORITIES

Effective June 2003



FLST (Main) Office
246 South 14th Street
Lincoln, NE 68508
(402) 471-9465

West Region ■
DSFM Kurt Arnusch
Scottsbluff, NE
(308) 632-4141

Southwest Region ■
DSFM Greg Rasmussen
Cozad, NE
(308) 784-4444

North Central Region ■
DSFM Larry Rinehart
Albion, NE
(402) 395-2445

Southeast Region ■
Open Position

Northeast Region ■
DSFM Terry Miller
Omaha, NE
(402) 498-025

DELEGATED AUTHORITIES

North Platte
George Lewis
North Platte Fire
(308) 535-6768

Grand Island
Fred Hotz
Grand Island Fire
(308) 385-5444

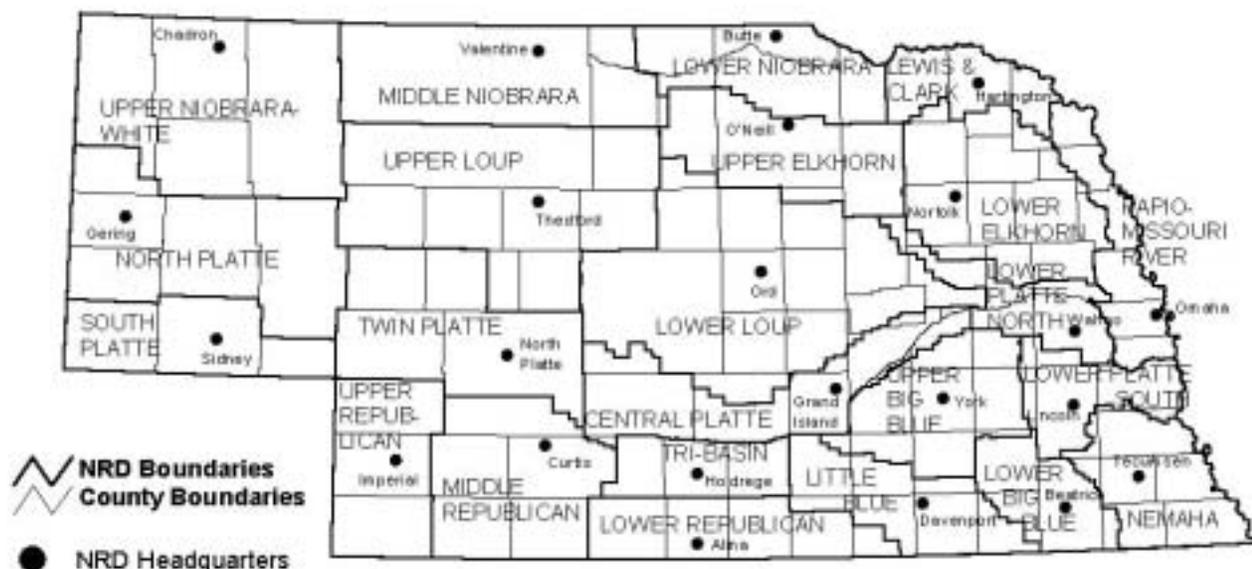
Norfolk
Terry Zwiebel
Norfolk Fire
(402) 844-2060

Lincoln
Bill Moody
Lincoln Fire Prevention
(402) 441-6437

Bellevue
Mike Stucker
Bellevue Fire
(402) 293-3153

Omaha
Tim Streitwieser
Omaha Fire Prevention
(402) 444-6383

Natural Resources District Offices



<u>NRD</u>	<u>ADDRESS</u>	<u>PHONE</u>
Central Platte	215 N. Kaufman Ave., Grand Island 68803	308-385-6282
Lewis & Clark	PO Box 518, Hartington 68739	402-254-6758
Little Blue	PO Box 100, Davenport 68335	402-364-2145
Lower Big Blue	805 Dorsey St., Beatrice 68310	402-228-3402
Lower Elkhorn	PO Box 1204, Norfolk 68701-1204	402-371-7313
Lower Loup	PO Box 218, Ord 68862	308-728-3221
Lower Niobrara	PO Box 350, Butte 68722-0350	402-775-2343
Lower Platte North	PO Box 126, Wahoo 68066	402-443-4675
Lower Platte South	PO Box 83581, Lincoln 68501-3581	402-476-2729
Lower Republican	PO Box 618, Alma 68920	308-928-2182
Middle Niobrara	526 East 1 st St., Valentine 69201	402-376-3241
Middle Republican	PO Box 81, Curtis 69025	308-367-4281
Nemaha	125 Jackson, Tecumseh 68450	402-335-3326
North Platte	PO Box 36, Gering 69341	308-436-7111
Papio-Missouri River	8901 S. 154 th St., Omaha 68138-3621	402-444-6222
South Platte	PO Box 294, Sidney 69162	308-254-2377
Tri-Basin	1308 2 nd Ave., Holdrege 68949	308-995-6688
Twin Platte	PO Box 1347, North Platte 69103-1347	308-535-8080
Upper Big Blue	105 Lincoln Ave., York 68467	402-362-6601
Upper Elkhorn	301 N. Harrison, O'Neill 68763	402-336-3867
Upper Loup	PO Box 212, Theadford 69166	308-645-2250
Upper Niobrara-White	430 E. 2 nd St., Chadron 69337	308-432-6190
Upper Republican	135 W. 5 th St., Imperial 69033	308-882-5173
State Association: NE Association of Resources Districts	601 S. 12 th St., Suite 201, Lincoln 68508	402-471-7670 877-777-6273